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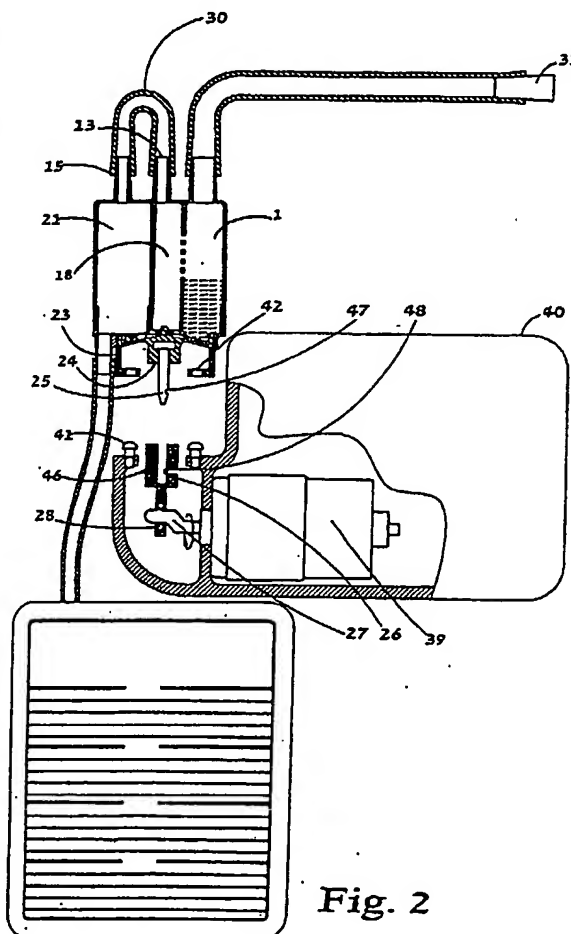
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(54) Abstract Title
Disposable pump with detachable motor

(57) A vacuum pump comprises a drive 40 and a manually disengageable, disposable pumping system connected thereto. The pumping system comprises a two or three chambered cannister 1, 18, 21 in which solids liquids and gases can be separated from one another. A pumping means such as a diaphragm 24 is attached to the cannister and sealed against it circumferentially. Activation of the drive means causes reciprocation of the pumping means to produce the pumping action.



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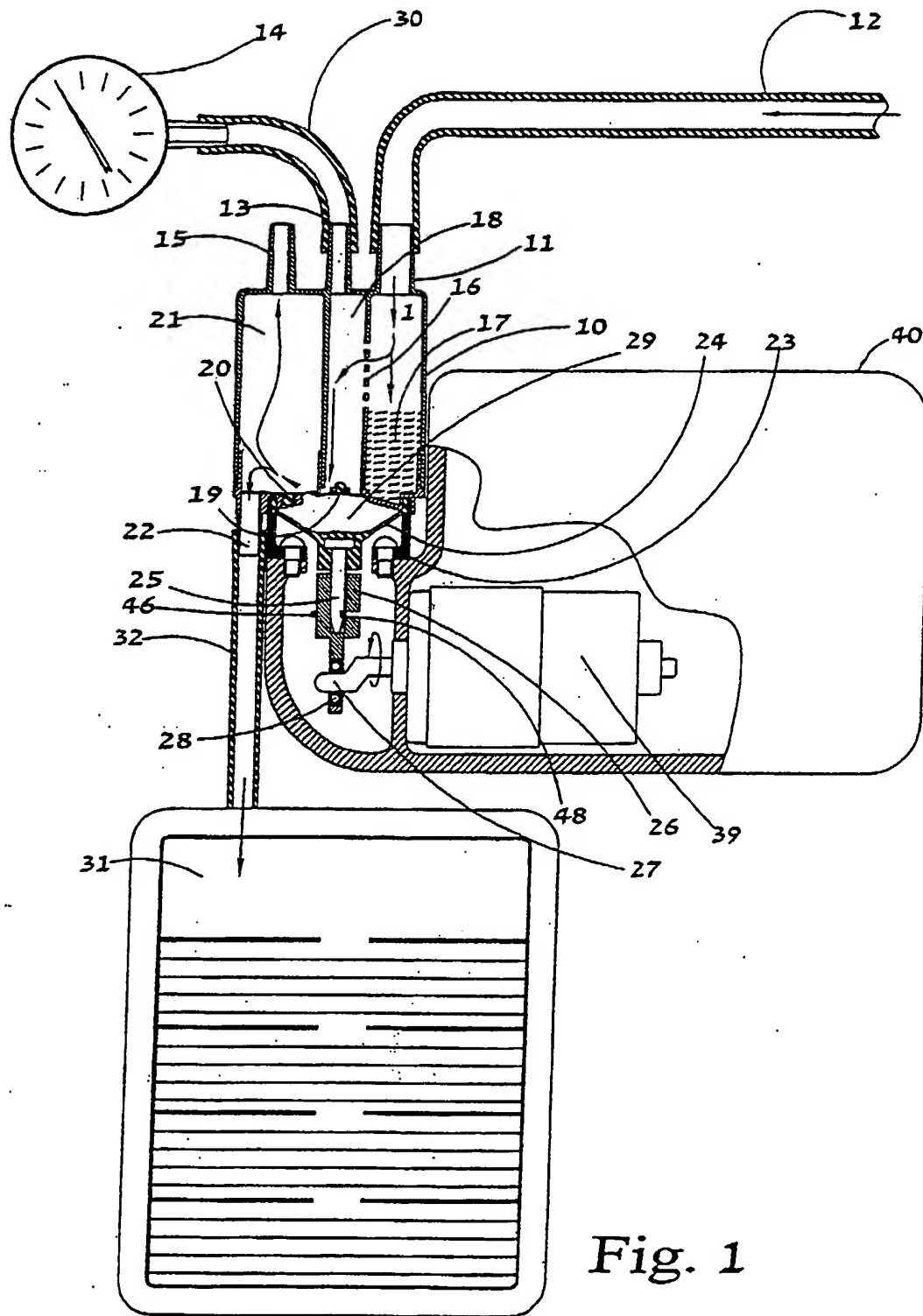


Fig. 1

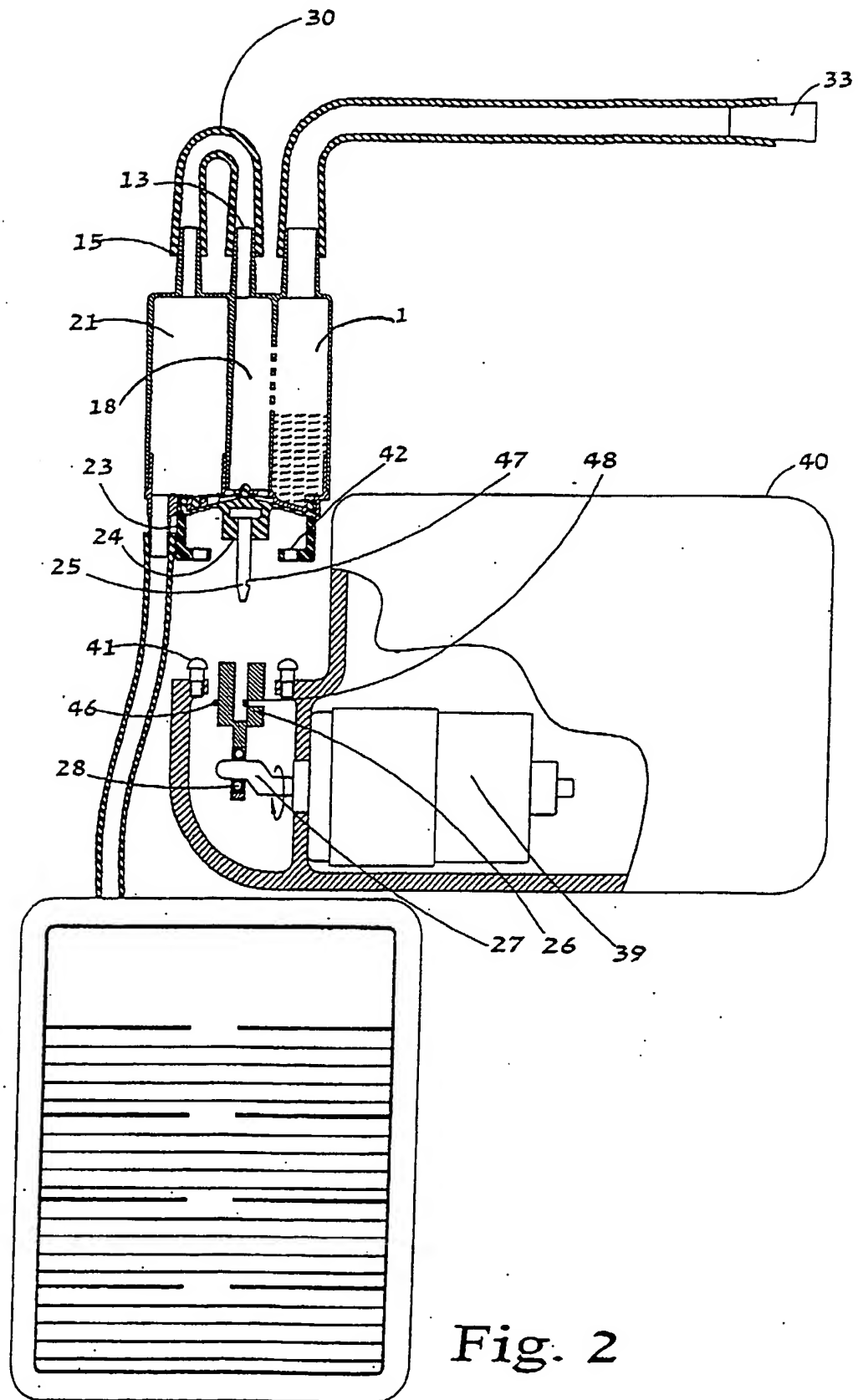


Fig. 2

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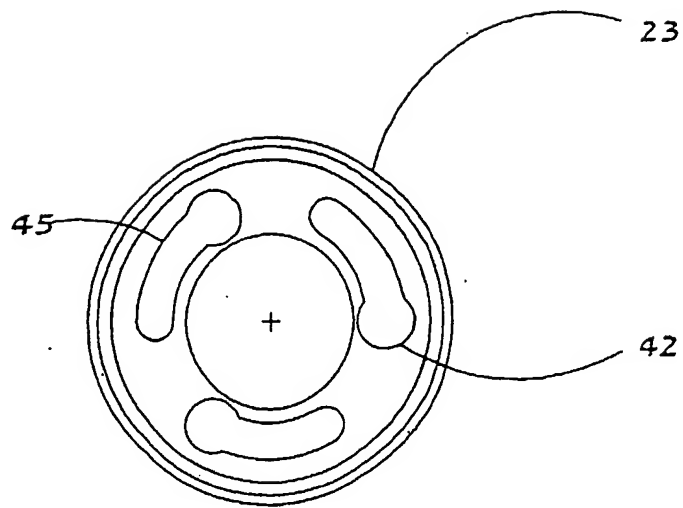


Fig.3

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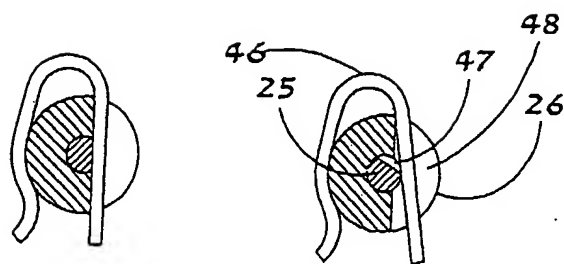


Fig.4

A COMPACT VACUUM PUMP

5 The present invention relates to a vacuum pump,
especially useful in the field of medicine. More
specifically, the pump disclosed herein comprises a
drive, and a disposable pumping system that can be
easily disengaged from the drive after use, to allow
for easy disposal of all pump components which come in
10 contact with the matter being sucked, together with the
contained matter. The pump should not be limited in
the volume of matter it is capable of sucking, while
maintaining uninterrupted vacuum pressure.

15 During medical surgery or emergency airway
clearing, body fluids such as blood, or emesis, are
subjected to suction. Vacuum pumps are utilized to
generate vacuum inside a suction canister, into which
the body fluids are drawn through a tube, called a
20 "suction catheter". Conventional vacuum pumps, also
termed "aspirators" in medicine, contain rigid vacuum
canisters into which the suctioned fluids are
collected, which maintain their shape and stiffness
under high vacuum pressure. Some suction canisters are
25 disposable and others can be removed for cleaning,
disinfection, and re-use.

Aspirators of the type described above are
characterized by a number of disadvantages, including
the following:

- 30 1. When a large volume of fluid is collected, the
suction canisters have to be relatively large in
volume. Most commonly, a canister of up to five liters
in volume is used. Large canisters slow the vacuum
rise rate, because of the large air volume to be
35 removed from the canister before a vacuum is created in
the canister strong enough to draw the suctioned

matter.

2. Since the air in the suction canister is drawn through the pump, it is very difficult to prevent contamination of the non-disposable pump components, such as the diaphragm, valves, cylinder or piston, even when the suction canister is disposed of after use. Contaminated pumps are a health hazard, as the air flowing through them is exhausted to the atmosphere.

3. Aspirators are used for drawing body fluids and emesis, which may contain solids. Air is also drawn into the pump, during aspiration. Vacuum pumps are generally efficient in pumping either air or fluids, but most pumps are inefficient in pumping all three types of matter.

Thus, conventional vacuum devices are large, bulky, costly and inefficient in performing their function.

In the present invention, the term "pumping system" generally refers to a system having at least the following components: a suction canister, a suction inlet, a waste outlet, and integral means for creating suction. The term "disposable vacuum pump" generally refers to a pump in which all components other than the drive are inexpensive, and therefore may be disposed of. One wishing to re-use the disposable components (or use similar, non-disposable components) may, however do so. The term "drive" generally refers to a pump component comprising of an electric motor, or other means by which a pump piston, or a diaphragm, may be caused to reciprocate, contained within a housing. The term "body fluids" refers typically to blood, emesis or mucus. The terms "three types of matter", "three types of media", and "three states of matter", refer to liquid, solid and gas. The terms "matter",

"media", and "material" are used interchangeably to refer to the material being suctioned. The term "load", or "high load", refers to the quantity and weight of the material being suctioned or pumped.

5

Embodiments of the invention may provide an improved vacuum pump, capable of pumping air or gas, liquid and solids, and capable of separating the three types of matter, to allow efficient pumping, while
10 collecting the liquid in a low cost bag.

Further embodiments may provide a pump in which all components that come in contact with body matter, or any other pumped media, can be easily disconnected and removed from the pump's drive means, to be
15 sterilized or disposed of. This leaves the non-disposable drive free from contamination. In prior-art pumps that have disposable canisters, the suctioned air is drawn through the pump, bringing the inside of the pump in contact with air which may be contaminated.
20 The inside of the pump is traditionally not accessible for cleaning.

Embodiments of the present invention may further provide a vacuum pump which is extremely fast in generating a high vacuum or suction pressure, yet doing
25 so with a relatively small vacuum canister and a low-capacity pump.

It is further desirable to provide a physically compact vacuum pump, with performance and capacity which are independent of its dimensions, and are
30 significantly higher than those of physically larger vacuum pumps and moreover to provide a vacuum pump which generates uninterrupted vacuum, independent of the volume of the vacuum canister, which does not fill up as do conventional vacuum canisters.

35 The vacuum pump comprises a drive, and a disposable pumping system connected to this drive (but designed to

be manually disengaged therefrom), wherein the disposable pumping system comprises:

- a) a three-chambered canister, wherein an inlet leads into the first chamber, and the first chamber has means for retaining solids and preventing their passage from said first chamber to the second chamber; and the second chamber has a one-way valve at its exit, said valve allowing passage of liquid and gas out of said second chamber; and the third chamber has an outlet for the discharge of air, and an additional outlet for the discharge of liquid; and said third chamber further has a one-way valve, at its inlet, allowing entry of liquid and gas through said valve, while preventing exit of matter through said valve;
- b) a highly flexible diaphragm, attached to said three-chambered canister, sealing against it circumferentially, wherein said flexible diaphragm is attached to a partition with said three-chambered canister, in which said valves are installed;
- c) a drive member attached to said diaphragm, wherein reciprocation of said drive member induces reciprocation of said diaphragm; and
- d) means for mounting and engaging said disposable pumping system to the housing of a drive, wherein said means are capable of simultaneously coupling the pump drive member to said drive.

The drive is coupled to the drive member, and the drive includes an electric motor rotating a crank, said crank being connected to reciprocating means, in such a way that activation of the drive induces reciprocation of the crank and of the drive member. The pumping

system is capable of being attached to or detached from the drive in a rapid and facile manner (in the preferred embodiment, accomplished by a single, simple, wrist twist motion).

5

According to a preferred embodiment of the present invention, the three-chambered canister has a volume of approximately 100 cc.

10

Further according to a preferred embodiment of the present invention, the pump includes a vacuum port outlet present in the second chamber, said outlet connected by tubing to an external vacuum gauge for the purpose of monitoring the pressure inside the first and second chambers.

15

Additionally according to preferred embodiment of the present invention, the means for retaining solids in the first chamber includes a sieve.

20

Moreover according to preferred embodiment of the present invention, the highly flexible diaphragm is capable of yielding or stretching when large quantities of fluid are contained within it. When subjected to high loads, the diaphragm is capable of stretching to effectively reciprocate only a fraction of its area (such as 50%) while the remainder of its surface remains stationary.

25

Still further according to preferred embodiments of the present invention, the vacuum pump additionally comprises means for sealing said three-chambered canister and preventing leakage of air or materials into or out of said canister; and further preventing loss of vacuum in first and second chambers.

30

According to embodiments of the present invention, the pump additionally comprises a disposable waste container, for collection of discharged liquid, attached to the liquid outlet of said third chamber. In a preferred embodiment, the disposable waste

35

container is a waste bag, having any appropriate size. In some preferred embodiments, the capacity of said waste bag is between 500 cc and 5 liters. The waste-collection bag is a low cost waste container, at
5 ambient pressure, which is easily disposed of along with the body fluids it contains, together with the pumping system.

Furthermore, according to the preferred embodiment of the present invention, the means for mounting and
10 engaging the pumping system to the drive housing comprise a mounting base protruding from the lower portion of the three-chambered canister, said mounting base adapted for mating and attaching to the drive housing. In the preferred embodiment, twisting of the
15 mounting base against the drive housing or mating portion thereof couples the two physically.

Still further yet, according to the preferred embodiment of the present invention, the drive rotates a crank, and a reciprocating rod receptacle is
20 connected to said crank, and said rod receptacle is adapted to mate with said drive member. In the preferred embodiment, a lock clip secures the drive member to the rod receptacle. Coupling said mounting base to said drive housing is affected simultaneously
25 with the securing of said drive member to the rod receptacle, in a single operation.

Additionally, the pumping system and the drive may be portable and may be operated on battery power. Moreover, the pumping system may additionally comprise
30 means for sealing said pumping system, for facilitating disposal of said pumping system, with all pumped matter contained.

Further according to preferred embodiments of the present invention, the pump is capable of generating
35 continuous unlimited flow of matter therethrough, while maintaining uninterrupted vacuum pressure. The

pump may be capable of generating a vacuum pressure of approximately 650 mm of Mercury as measured in the first and second chambers.

5 Additionally, in a preferred embodiment, the pump further comprises suction catheter tubing attached to the inlet present in said first chamber, allowing entry of matter into the three-chambered canister.

10 Unlike common diaphragm pumps, the diaphragm in this invention is flexible and not restrained by a rigid piston. The flexibility of the diaphragm allows it to stretch and conform to the pumped matter, irrespective of the reciprocal motion of the rigid drive member. Thus, when the diaphragm encounters
15 resistance it stretches and yields, allowing uninterrupted motion of the reciprocating drive member.

 The three-chambered canister, the diaphragm and the one-way valves advantageously comprise an integral pumping system, which can easily be attached to a
20 drive, which causes the drive member to reciprocate. Such a drive, as described, may be an electric motor, whose output shaft has a crank to which the drive member is connected. The electric motor will thus, when powered, affect pumping from one chamber of the
25 canister to the other. The pumping system can easily be disengaged from the drive after use, and be sterilized or disposed of. The ability to completely separate the heart of the pump and its associated chambers and tubing conduits, from the drive motor
30 allows disposal or sterilization of all pump components that come in contact with pumped matter. It would be obvious to those skilled in the art that means other than an electric motor may be utilized to induce the reciprocal motion of the drive member.

35 The three-chambered canister is constructed in a manner such that the solids entering the chamber are

trapped and prevented from entering further into the pump and affecting its performance by blocking the valves and tubing. It would be obvious to those skilled in the art that when the pumped matter is not likely to include solids, there would be no need to prevent them from reaching the pump one-way valves, and thus the pumping system hereby described would function equally well without the first chamber. A pump having only two chambers, to be used in such case, is thus described below as well. Additionally, the pumped air is separated from the fluid, and released to the atmosphere, so that liquid, and not air, is collected in the waste bag, thereby utilizing the volume of the waste bag efficiently. Thus, the capacity of the pump to suck or collect fluids is not limited by the size of the chamber into which the fluid is drawn, and even a small chamber can be utilized to pump large volumes of fluid, limited only by the capacity of the waste bag. This is in contrast to pumps of the prior art, in which the canister or chamber size limits the amount of matter that may be suctioned, and when large canisters are used to overcome this limitation, evacuating the large canister by the pump becomes a slow process.

The present invention can be utilized in the field of medicine, to aspirate body fluids, emesis and mucus; however, the scope of the invention is not limited to medical use alone, and the vacuum pump may be utilized in other fields as well. An important feature of the pump is the ability easily and economically to remove and replace all components that come in contact with the materials being pumped, preventing any harmful contamination. The pump can therefore, find application in the field of chemistry as well, where prior art pumps are difficult to clean after use.

In addition, there is thus provided in an alternative aspect of the present invention, a vacuum

pump for the pumping of liquid and gas, (preferably not for use in pumping of solids), comprising a drive, and a manually disengageable disposable pumping system connected to said drive, wherein said disposable
5 pumping system comprises:

- a) a dual-chambered canister, wherein the first chamber has an inlet and a one-way valve at the exit of said first chamber, said valve allowing passage of liquid and gas out of
10 said first chamber; and the second chamber has an outlet for the discharge of air, and an additional outlet for the discharge of liquid; and said second chamber is further connected via a one-way valve, allowing
15 entrance of liquid or gas through said valve, while preventing exit of liquid or gas through said valve;
- b) a highly flexible diaphragm, attached to said dual-chambered canister, sealing against it circumferentially, wherein said flexible diaphragm is attached to a partition with
20 said dual-chambered canister in which said valves are installed;
- c) a drive member attached to said diaphragm, reciprocation of said drive member inducing reciprocation of said diaphragm; and
25
- d) means for mounting and engaging said disposable pumping system to the housing of a drive, wherein said means are capable of
30 simultaneously coupling the drive member to said drive.

In the vacuum pump the drive is coupled to the pumping system so that activation of said drive
35 induces reciprocation of said flexible diaphragm; and the pumping system is capable of being

attached to or detached from said drive in a rapid and facile manner.

5 BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the invention embodiments of it will now be described, by way of example, with reference to the accompanying drawings, in which:

10 Fig. 1 is a cross-sectional view of a preferred disposable vacuum pump having a three-chambered canister connected to a waste bag, wherein the suction is created by reciprocating a diaphragm by an electric motor drive;

15 Fig. 2 is a cross-sectional view of the "pumping system" disengaged from the "drive", to be disposed of as one integral unit;

20 Fig. 3 is a view of a mounting base, with a bayonet arrangement for quick - twist engagement and disengagement of the disposable components; and

Fig. 4 is a cross-sectional view of the locking mechanism, utilized to attach the pump drive member to the receptacle rod of the electric motor.

25 DETAILED DESCRIPTION OF THE INVENTION

It is appreciated that the detailed description that follows is intended only to illustrate certain preferred embodiments of the present invention. It is in no way intended to limit the scope of the invention,
30 as set out in the claims.

Referring now to Fig. 1, there is provided a vacuum pump containing a three-chambered canister 10, which is employed for the performance of several
35 different functions. The three-chambered canister 10 has an inlet 11 in its first chamber 1. A suction tube

catheter 12 is connected to the inlet 11. In the second chamber 18 a vacuum outlet port 13 is connected to a vacuum gauge 14. In the third chamber 21 an air discharge outlet 15 is present, which is open to the atmosphere. The first chamber 1 contains a sieve 16, utilized to prevent solids 17 from entering the second chamber 18, also termed the "liquid chamber". Two one-way umbrella valves 19 and 20 are present in the bottom of the second chamber 18 and the third chamber 21, respectively. The third chamber 21 is at ambient pressure, and has a liquid outlet 22. To the bottom of the three-chambered canister 10 there is attached a mounting base 23, used to mount the canister and its associated tubing 12 on the drive housing 40 or on a docking means connected to the drive housing. The mounting base 23 is also utilized to secure a diaphragm 24 to the underside of the three-chambered canister 10. The diaphragm 24 has an integral rod-shaped drive member 25, which is inserted into a corresponding cavity in a receptacle rod 26, pivotally attached to a drive 40, via a crank 27 coupled to a bearing 28. Upon activation of the motor 39, the crank 28 is rotated by the motor 39, which reciprocates the receptacle rod 26, causing the diaphragm 24 to increase and decrease the volume of the cavity 29 it forms. This creates a vacuum therein, capable of drawing towards it, and thus pumping, air or fluid that pass through the one-way umbrella valves 19 and 20.

While the preferred embodiment describes a motor-crank combination as the means by which to reciprocate diaphragm 24, it would be apparent that other drive means may be used to create the reciprocal movement of the diaphragm.

Air, liquid and solids may enter the three-chambered canister 10 through a suction tube 12, which may, by way of example, be inserted into a patient's

mouth, for the removal of emesis. The three states of matter being pumped enter the three-chambered canister 10 through the inlet 11. Solids 17 are prevented from moving further than the first chamber 1, by sieve 16. Liquids and air enter the second chamber (liquid chamber) 18, which is under vacuum when diaphragm 24 reciprocates, driving them past one-way umbrella valve 20, into the third chamber 21. The vacuum level in the liquid chamber 18 is monitored by a vacuum gauge 14, connected to the vacuum outlet port 13 via a conduit 30. The air and liquid entering the third chamber 21 are separated, whereupon the liquid is drained into a waste bag 31 through a drain tube 32, and the air is driven out to atmosphere through an air discharge outlet 15.

From the description above, it is clear that the three-chambered canister 10 is the heart of the pump, to which the diaphragm 24 is attached to perform the pumping function together with the one-way umbrella valves 19 and 20. Out of the three chambers that make up the three-chambered canister, only one, the liquid chamber 18, is under vacuum. The three-chambered canister is partitioned by the sieve 16; the first chamber 1 and the third chamber 21 are essentially at ambient pressure.

The pump hereby described is distinct in its capability to suck liquid, solids and air or any mixture of the three, and to direct each of the three matter types to their respective destination while separating them. The three types of matter are separated in order to prevent clogging of the pump by solids suctioned, and in order to collect only fluid to dispose of, and not gas, and thus minimize the volume of the waste material for disposal, and of the canister which holds this waste material. It is also of particular importance to note that air and liquid can

be pumped through the pump continuously, at any volume, limited only by the volume of the waste bag 31 to contain the pumped liquids.

5 The pump's ability to pump air and liquid, unlike conventional pumps, which are efficient in pumping only one type of matter, is enhanced by the flexibility of the diaphragm 24. Unlike conventional pump diaphragms, which are rigidified by a piston or ribbing, to prevent them from excessive flexing, which reduces
10 displacement, the diaphragm 24 described in this embodiment is particularly flexible, so it can yield when encountering heavy loads, such as those present when pumping liquid. This diaphragm flexibility also provides an additional substantial advantage: when the
15 vacuum in the pumping cavity 29 is high, the diaphragm 24 stretches to allow the reciprocation of the receptacle rod 26 to occur, at minimal burden to the "drive", which in the preferred embodiment comprises an electric motor 39.

20 Referring to **Figure 2**, to obtain high vacuum levels it is necessary to extract all air from the pumping cavity 29 when the diaphragm 24 is at its upper travel extremity, as illustrated in Fig. 2. This function, in a conventional vacuum pump, will cause
25 damage to the pump when liquid or solids enter the pumping chamber, as they cannot be expelled through the pump's outlet valve fast enough. In the disclosed invention, the flexibility of the diaphragm 24 will allow it to yield, or bulge, when encountering
30 resistance as a result of liquid or solid presence, preventing excessive forces and the ensuing damage.

 An additional important function of the flexibility of the diaphragm 24 is its ability to stretch and yield, so that when the vacuum level in the
35 pumping cavity 29 is high, only a smaller effective area of the diaphragm 24 reciprocates, and stretches,

requiring less power from the motor 39 to effect reciprocation.

In Figure 2, the drive 40, which contains the motor 39, crank 27 and reciprocating receptacle rod 26, is shown disengaged from all other parts, since the drive will be re-used, while all other parts, which have directly contacted the matter being pumped, are slated for disposal, and are termed the "disposable pumping system". The disposable pumping system, essentially comprising the canister, the diaphragm, associated valves, the disposable waste bag, and associated tubing, are shown in Figure 2 after all outlets have been sealed for disposal. The suction tube 12 is plugged with a plug 33 to prevent any liquid from leaking out of it. The conduit 30 is disengaged from the vacuum gauge 14 and attached to the air discharge outlet 15, sealing all possible leak paths from three-chambered canister 10.

It will be appreciated by persons skilled in the art that the drive 40, which is the only non-disposable hardware in the preferred embodiment, does not come in contact with any of the pumped media, unlike conventional aspirators or suction pumps, which pass the suctioned air through them, and may thus be contaminated by infectious air.

The method and means for attachment and mounting of the disposable pumping system to drive 40 is illustrated in Figs. 2 and 3, whereby the mounting base 23 is placed on top of retainers 41, shown in Fig. 2. The retainers 41 protrude from a shelf- or step-like part of the drive 40 and have a large mushroom-shaped head, which passes through large openings 42 in a flange of the base 23, as shown in Fig. 3. When the three-chambered canister 10 is rotated clockwise, with its mounting base 23, the large heads of the retainers 41 engage slots 45, attaching the mounting

base 23 to the drive 40, in a bayonet-type fastening action using a 45-degree twist. This action is similar to attaching a cap to a glass jar. The drive member 25, shown in Figs. 1, 2, is inserted into the receptacle rod 26, simultaneously with the attachment of the mounting base 23 to the housing of the drive 40.

Referring to Figure 4, a spring-loaded lock-clip 46 keys and locks the drive member 25 to the receptacle rod 26, when the lock clip engages pre-aligned slots 48 present in the drive member 25 and the receptacle rod 26. The disengagement of the mounting base 23 from the drive 40 is effected, simultaneously with disengagement of the drive member 25 from the receptacle rod 26, when both are rotated counterclockwise, as illustrated in Fig. 4, by drive member 25 pushing lock clip 46 out of its slot 47, eliminating the keying between drive member 25 and receptacle rod 26. This action is similar to the removal of a cap from a jar, by twisting counterclockwise and lifting.

While only one form of engagement of canister 10 to drive 40 was described in the preferred embodiment of this invention, it would be clear to those skilled in the art, that other similar methods for quick fastening of these parts, can be utilized effectively.

The above-described method of engagement has, however, an important feature that should be noted. Since the receptacle rod 26 may be at its lower position at the time when the drive member 25 is inserted into it, slots 47 and 48 may come into alignment only when motor 39 is powered and crank 27 raises receptacle rod 26 allowing lock clip 46 to key slots 47 and 48. Thus, the insertion of the drive member 25 into the receptacle rod 26 enables engagement, rather than fastening the two together.

CLAIMS

1. A vacuum pump capable of pumping solid,
liquid and
5 gas, or any combination thereof, especially useful for
suctioning body liquids, comprising a drive and a
manually disengageable disposable pumping system
connected to said drive, wherein said disposable
pumping system comprises:

10 a three-chambered canister, wherein the first
chamber has an inlet, and means are provided
for retaining solids and preventing their
passage from said first chamber to the second
chamber; the second chamber having a one-way
15 valve at its exit, said valve allowing
passage of liquid and gas out of said second
chamber; the third chamber having an outlet
for the discharge of air, and having an
additional outlet for the discharge of
20 liquid; and said third chamber further being
connected via a one-way valve, allowing
entrance of liquid or gas through said valve,
while preventing exit of liquid or gas
through said valve;

25 a highly flexible diaphragm, attached to said
three-chambered canister, sealing against it
circumferentially, said flexible diaphragm
being attached to a partition with said
three-chambered canister in which said valves
30 are installed;

a drive member attached to said diaphragm,
reciprocation of said drive member inducing
reciprocation of said diaphragm; and
means for mounting and engaging said disposable
35 pumping system to the housing of a drive,
these means being capable of simultaneously

coupling the drive member to the drive;

wherein, in the assembled vacuum pump, the drive is coupled to the pumping system in such a way that activation of the drive induces reciprocation of said flexible diaphragm, and the pumping system is capable of being attached or detached from drive in a rapid and facile manner.

2. A vacuum pump according to claim 1, wherein the three-chambered canister has a volume of approximately 100 cc.

3. A vacuum pump according to claim 1 or 2, additionally comprising a vacuum outlet port, present in said second chamber, said outlet connected by tubing to an external vacuum gauge for the purpose of monitoring the pressure inside the first and second chambers.

4. A vacuum pump according to any preceding claim, wherein said means for retaining solids in the first chamber are comprised of a sieve.

5. A vacuum pump according to any preceding claim, wherein said highly flexible diaphragm is capable of yielding or stretching when exposed to high load or resistance.

6. A vacuum pump according to any preceding claim, wherein said highly flexible diaphragm, when subjected to high loads, is capable of stretching to effectively reciprocate only a fraction of its area while the remainder of its surface remains stationary.

7. A vacuum pump according to any preceding

claim, additionally comprising a disposable waste container, for collection of discharged liquid, attached to the liquid discharge outlet of said third chamber;

5

8. A vacuum pump according to claim 7, wherein said disposable waste container is a waste bag, having any appropriate size.

10

9. A vacuum pump according to claim 8, wherein the capacity of said waste bag is between 500 cc and 5 liters.

15

10. The vacuum pump according to any preceding claim, wherein the means for mounting and engaging said pumping system to said drive comprise a mounting base protruding from the lower portion of the three-chambered canister, said mounting base adapted for mating and attaching to said drive housing.

20

11. A vacuum pump according to any preceding claim, wherein said drive rotates a crank, and said drive is coupled to said drive member via a reciprocating rod receptacle connected to said crank, and said rod receptacle is adapted to mate with said drive member.

25

12. A vacuum pump according to claim 11, wherein coupling said mounting base to said drive housing, is affected simultaneously with the securing of said drive member to the rod receptacle, in a single operation.

30

13. A vacuum pump according to claim 11 or 12, additionally comprising a lock clip, capable of securing the drive member to the rod receptacle.

35

14. A vacuum pump according to any preceding claim, wherein said pumping system and said drive are portable and may be operated on battery power.

5 15. A vacuum pump according to any preceding claim, wherein said pumping system additionally comprising means for sealing said disposable pumping system, for facilitating disposal of said pumping system, while containing the pumped waste.

10 16. A vacuum pump according to any preceding claim, wherein said pump is capable of maintaining an unlimited flow of matter therethrough, while maintaining uninterrupted vacuum pressure.

15 17. A vacuum pump according to any preceding claim, wherein said pump is capable of generating a vacuum pressure of approximately 650 mm of Mercury as measured in the first and second chambers.

20 18. A vacuum pump according to any preceding claim, wherein said pump is capable of suctioning, continuously, an unlimited volume of matter therethrough.

25 19. A vacuum pump according to any preceding claim, additionally comprising a suction catheter tube attached to the inlet present in said first chamber, for allowing entry of matter into said three-chambered
30 canister.

 20. A vacuum pump capable of pumping liquid and gas, comprising a drive, and a manually disengageable disposable pumping system connected to said drive,
35 wherein said disposable pumping system comprises:
a dual-chambered canister, wherein the first chamber

has an inlet and a one-way valve at the exit of the first chamber, said valve allowing passage of liquid and gas out of said first chamber; and the second chamber having an outlet for the discharge of air and an additional outlet for the discharge of liquid; said second chamber further being connected via a one-way valve, allowing entrance of liquid or gas through said valve, while preventing exit of liquid or gas through said valve;

a highly flexible diaphragm, attached to said dual-chambered canister, sealing against it circumferentially, wherein said flexible diaphragm is attached to a partition with said dual-chambered canister in which said valves are installed;

a drive member attached to said diaphragm, reciprocation of said drive member inducing reciprocation of said diaphragm; and

means for mounting and engaging said disposable pumping system on the housing of a drive, wherein said means are capable of simultaneously coupling the drive member to said drive;

wherein in the assembled vacuum pump, said drive is coupled to said pumping system, such that activation of said drive induces reciprocation of said flexible diaphragm; and wherein said pumping system is capable of being attached or detached from said drive in a rapid and facile manner.

21. A vacuum pump capable of pumping liquid and gas, comprising a drive and a disengageable disposable pumping system connected to the drive, wherein the disposable pumping system comprises:

a first chamber having an inlet and a first one-way

valve at its exit, allowing passage of liquid and
gas out of the first chamber; and a second chamber
having an outlet for the discharge of air and an
outlet for the discharge of liquid; and an inlet
5 via a second one-way valve, allowing entrance of
liquid or gas through the valve while preventing
exit of liquid or gas through the valve;
a flexible diaphragm sealing against the exterior of
the chambers so as to define a pump cavity whose
10 inlet is the first one-way valve and whose outlet
is the second one-way valve; and
a drive member attached to the diaphragm,
reciprocation of which induces reciprocation of
the diaphragm;
15 the pump further comprising means for mounting the
disposable pumping system on the housing of the drive,
and for coupling the drive member to the drive.

22. A pump system substantially as described
20 herein with reference to the attached drawings.

CLAIMS

1. A vacuum pump capable of pumping solid, liquid and gas, or any combination thereof, comprising a drive, and a manually disengageable disposable pumping system connected to said drive, wherein said disposable pumping system is comprised:
 - a three-chambered canister, wherein the first chamber has an inlet, and means are provided for retaining solids and preventing their passage from said first chamber to the second chamber; and the second chamber having a one-way valve at its exit, said valve allowing passage of liquid or gas out of said second chamber; and the third chamber having an outlet for the discharge of air, and having an additional outlet for the discharge of liquid; and said third chamber further being connected via a one-way valve, allowing entrance of liquid or gas through said valve, while preventing exit of liquid or gas through said valve;
 - a highly flexible diaphragm, attached to said three chambered canister, sealing it circumferentially, said flexible diagram being attached to a partition with said three-chambered canister, in which said valves are installed;
 - a drive member attached to said diaphragm, reciprocation of said drive member inducing reciprocation of said diaphragm; and
 - a bayonet arrangement for selectably simultaneously coupling said disposable pumping system to the housing of a drive and said drive member to the drive, and for selectably simultaneously decoupling said disposable pumping system from the housing of said drive and said drive member from said drive.
2. A vacuum pump according to claim 1, wherein the three-chambered canister has a volume of approximately 100 cc.
3. A vacuum pump according to claim 1 or 2, additionally comprising a vacuum outlet port, present in said second chamber, said outlet connected by tubing to an external vacuum gauge for the purpose of monitoring the pressure inside the first and second chambers.
4. A vacuum pump according to any of the preceding claims, wherein said means for retaining solids in the first chamber are comprised of a sieve.

5. A vacuum pump according to any of the preceding claims, wherein said highly flexible diaphragm is capable of yielding or stretching when exposed to high load or resistance.
6. A vacuum pump according to any of the preceding claims, wherein said highly flexible diaphragm, when subjected to high loads, is capable of stretching to effectively reciprocate only a fraction of its area while the remainder of its surface remains stationary.
7. A vacuum pump according to any of the preceding claims, additionally comprising a disposable waste container, for collection of discharged liquid, attached to the liquid discharge outlet of said third chamber.
8. A vacuum pump, according to claim 7, wherein said disposable waste container is a waste bag, having any appropriate size.
9. A vacuum pump according to claim 8, wherein the capacity of said waste bag is between 500 cc and 5 liters.
10. The vacuum pump according to any of the preceding claims, wherein the means for mounting and engaging said pumping system to drive comprise a mounting base protruding from the lower portion of the three-chambered canister, said mounting base adapted for mating and attaching to said drive housing.
11. A vacuum pump according to any of the preceding claims, wherein said drive rotates a crank, and said drive is coupled to said drive member via a reciprocating member connected to said crank, and said member is adapted to be coupled with said drive member.
12. A vacuum pump according to claim 11, wherein coupling said mounting base to said drive housing, is effected simultaneously with the securing of said drive member to the reciprocating member, in a single operation.
13. A vacuum pump according to claim 11 or 12, additionally comprising a lock clip, capable of securing the drive member to the reciprocating member.

14. A vacuum pump according to any of the preceding claims, wherein said pumping system additionally comprising means for sealing said pumping system, for facilitating disposal of said pumping system, while containing the pumped waste.
15. A vacuum pump according to any of the preceding claims, wherein said pump is capable of generating a vacuum pressure of approximately 650 mm of Mercury as measured in the first and second chambers.
16. A vacuum pump according to any of the preceding claims, additionally comprising a suction catheter tube attached to the inlet present in said first chamber, for allowing entry of matter into said three-chambered canister.
17. A vacuum pump capable of pumping liquid and gas, comprising a drive, and a manually disengageable disposable pumping system connected to said drive, wherein said disposable pumping system comprises:
- a dual-chambered canister, wherein the first chamber has an inlet and a one-way valve at the exit of the first chamber, said valve allowing passage of liquid and gas out of said first chamber; and the second chamber having an outlet for the discharge of air and an additional outlet for the discharge of liquid, said chamber further being connected via a one-way valve, allowing entrance of liquid or gas through said valve, while preventing exit of liquid or gas through said valve;
 - a highly flexible diaphragm, attached to said dual-chambered canister, sealing against it circumferentially, wherein said flexible diaphragm is attached to a partition with said dual-chambered canister in which said valves are installed;
 - a drive member attached to said diaphragm, reciprocation of said drive member inducing reciprocation of said flexible diaphragm; and
 - a bayonet arrangement for selectably simultaneously coupling said disposable pumping system to the housing of a drive and said drive member to the drive, and for selectably simultaneously decoupling said disposable pumping system from the housing of said drive and said drive member from said drive.

18. A vacuum pump capable of pumping liquid and gas, comprising a drive and a disengageable disposable pumping system connected to the drive, wherein the disposable pumping system comprises:

a first chamber having an inlet and a first one-way valve at its exit, allowing passage of liquid and gas through the first chamber; and a second chamber having an outlet for the discharge of air and an outlet for the discharge of liquid; and an inlet via a second one-way valve, allowing entrance of liquid or gas through the valve while preventing exit of liquid or gas through the valve;

a flexible diaphragm sealing against the exterior of the chambers so as to define a pump cavity whose inlet is the first one-way valve and whose outlet is the second one-way valve; and

a drive member attached to the diaphragm, reciprocation of which induces reciprocation of the diaphragm;

the pump further comprising means for mounting the disposable pumping system on the housing of the drive, and for coupling the drive member to the drive.

19. A pump system substantially as described herein with reference to the attached drawings.



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Claims searched: 1 - 20

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Patents Act 1977 Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:
UK Cl (Ed.T): F1W (WCA, WDX, WDL, WDM); A5R (RCEB)
Int Cl (Ed.7): F04B (9/02, 17/00, 17/03, 35/00, 39/16, 53/22); A61M (1/00)
Other: Online: WPI; EPODOC; JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	GB 2124712 A (MEDTRONIC INC) See especially screws 30 & 32 in figures 1 and 2, which could be unscrewed to detach the motor	
A	EP 1045146 A2 (CLEMENS MICHELER) See English abstract	
A	EP 0494375 A1 (IWAKI CO LTD) See especially column 4 lines 45 - 46	
A	US 4842584 (ABBOTT LAB) See especially column 1, paragraph 2 and chambers 90, 82 & 22	
A	US 4798589 (FISHER SCIENT GROUP INC) See especially column 2 line 35 - column 4 line 59	
A	US 4639245 (OXIMETRIX) See especially figure 1	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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